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ABSTRACT

One of a series of curriculum guides prepared for the metal occupations cluster of the construction/fabrication occupational group, this guide identifies the essentials of the machinist trade as recommended by the successful machinist. An instructional program based upon the implementation of this guide is expected to prepare a student to adequately perform entry level tasks required of a machine operator or to enter a post-secondary technical or apprenticeship program in machine shop where additional depth can be realized. Trade tasks or information are listed in chart form under the headings of safety; tools and equipment; computations and estimations; operations and/or jobs; engine lathe; boring, drilling, and reaming; tap and die threading; milling; band sawing; grinding; alloy, metal, and machining characteristics; and general competencies. Space is provided on the charts to record for each item the date completed, teaching methods used, and teaching materials used. Also included are a list of teacher responsibilities, sources of occupational information, recommended tests and references, and a chart depicting the total construction/fabrication occupational curriculum. A typical application for employment and a sample trade and industrial education injury report are appended. (HD)

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TRADE AND INDUSTRIAL EDUCATION

TRADE PREPARATORY TRAINING GUIDE

MACHINE SHOP

U.S. DEPARTMENT OF HEALTH, EDUCATION & WELFARE
NATIONAL INSTITUTE OF EDUCATION
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DEFINITIONS USED IN THIS GUIDE

Major Occupational Group

A grouping of similar and related occupational area clusters. These groups include occupations that have been determined to be the most relevant and pertinent for inclusion in vocational education in Nebraska.

Occupational Area Clusters

These clusters are distinguishable in terms of similar work performed, materials used, products produced, and/or services rendered. They include a wide variety of common occupational skills and knowledge.

Occupation

The career or employment engaged in by an individual for remuneration. This activity includes technical competencies and related technical information often referred to as one's vocation.

Technical Competency

The specific tasks required for a vocational trade and industrial graduate to perform successfully at the entry level in an occupational area. These technical competencies apply to the psychomotor domain and include elements which emphasize motor skills such as: operate a machine; measure; etc.

Related Technical Information

The information the entry level worker must know in order to make appropriate trade decisions which will allow him to adequately perform the tasks or technical competencies of his occupation. This information applies to the cognitive domain and includes elements which are intellectual outcomes such as: knowledge and understanding.

Related General Information

Information which is desirable and good for the tradesman to know but which is not necessary to do his work properly; information that is nice to know, such as the history and development of his trade.

Related Guidance Information

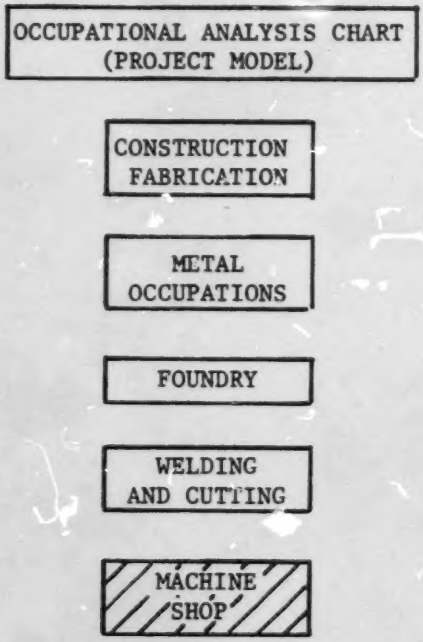
Information that helps the student choose, prepare for, secure, hold, and make progress in an occupation.

Entry Level

The technical competencies and related technical information deemed necessary by industry for obtaining and holding a job in a specific occupational area. This level of employment includes the technical competencies and related technical information that will be utilized by the employee within the first year of employment.

OCCUPATIONAL ANALYSIS CHART

The chart on this page shows machine shop as it relates to other occupations within the Metal Occupations cluster. Metal Occupations is one of two clusters which is a part of the major occupational group entitled Construction/Fabrication. This guide is concerned with Machine Shop only. Other guides have been prepared for each of the occupations found in this chart and are available through the Nebraska State Department of Education.



INTRODUCTION

This curriculum guide has been prepared with the help of competent craftsmen in the machine trades. The funds that made this guide a reality were provided through a federal research grant in cooperation with the Nebraska State Board for Vocational Education and sponsored by the Nebraska Research Coordinating Unit.

Curriculum guides have been prepared for several trade and industrial occupational clusters from which high school teachers can develop appropriate occupational related experiences for their students. The major occupational groups, occupational area clusters, and occupations are shown in graphic form on pages of this guide.

Selection of trades within four major occupational groups have been made based on a three year survey by the Nebraska Research Coordinating Unit on needs of Nebraska business and industry. This study has identified the occupations with the greatest need for employees. A related set of curriculum guides have been prepared for these occupations.

GUIDANCE INFORMATION

The U.S. Department of Labor has developed an extremely helpful book entitled, "Occupational Outlook Handbook." This annual publication provides a very complete description of the activities of the persons employed in the occupations represented in the Nebraska trade and industrial curriculum guides. Information concerning current and future opportunities is a major portion of this publication. Inexpensive reprints in booklet form that describe individual occupations are available through the Department of Labor. These booklets should be used by trade and industrial teachers and school guidance counselors for the most up-to-date guidance information about a particular occupation.

Number	Title	Price
1700-105	Machining Occupations All-round Machinists, Machine Tool Operators, Tool and Die Makers, Instrument Maker, Setup Men	.15
1700-113	Welders, Oxygen and Arc Cutters	.10
1700-123	Foundries Patternmakers, Molders Coremakers	.15

THE MACHINE SHOP GUIDE

This guide uses the title Machine Shop as the most logical descriptive term for identifying a particular related group of workers. Identification of specific job titles within this group should be determined by referring to the "Dictionary of Occupational Titles." The USOE classification system for coding instructional programs has assigned 600.280-281 to the instructional program, Machine Shop.

The information within this guide identifies the essentials of the machinist trade as recommended by the successful machinist. An instructional program based upon the implementation of this guide will prepare a student to adequately perform entry level tasks required of a machine operator or to enter a post-secondary technical or apprenticeship program in machine shop where additional depth can be realized.

The tasks and/or competencies identified within these covers are those agreed upon by a jury of reputable Nebraska machinists. A separate group of persons directly employed within this trade in Nebraska have further verified these tasks and/or competencies. Jury members, tradesmen, and educators who contributed toward the development of content for this guide are listed in the front.

Course offerings in trade and industrial education in Nebraska are to be organized within two period blocks of time each day, five days a week. Time is to be set aside for classroom instruction directly related to manipulative laboratory instruction. The remainder of the student's school day is to be utilized for general education subjects.

USE OF THIS GUIDE

The use of curriculum guides for trade and industrial education in Nebraska secondary schools may vary greatly, depending upon the depth and breadth of each school district's vocational program. Large school districts, for example, may utilize one particular curriculum guide to develop a course in a trade area such as machine shop. A small school district may, on the other hand, incorporate several curriculum guides to develop a course in the construction fabrication occupational cluster.

The manipulative content identified in this guide is deemed necessary for inclusion in a course that is designed to prepare entry level machinist. While not all secondary school facilities in Nebraska are equipped to expose students to all of this content through hands-on experience, it is assumed that this content will through some media become related technical information. This will insure inclusion of all content and provide at least discussion level understanding.

This guide is written with the assumption and expectation that the related technical information necessary to perform technical competencies will be an integral part of instruction. Thus, occupational decisions that must be made by an entry level worker will be developed along with each related manipulative activity.

The machine shop instructor who uses this guide is responsible for including the identified related technical information as well as the identified manipulative tasks. He is also responsible for the identification of competencies pertaining to general and guidance information, even though this information is not specifically identified for him.

Definitions for various terms used in this guide are presented in the front.

TEACHER RESPONSIBILITIES*

1. Use the American Vocational Association National Safety Council's "National Standards School Shop Safety Inspection Check List" for shop safety inspections. (Available from American Vocational Association, 1510 "H" Street, N.W., Washington, D.C. 20005)

2. Use safety check list to assure safe factors exist.

3. Require students to report ALL accidents to instructor.

4. Keep complete records of ALL accidents on file.

5. Report ALL accidents to the school administrator.

6. Develop safety consciousness in the students through teacher example--always doing things in the safe way.

7. Give shop demonstrations stressing safe use of machines.

8. Give shop demonstrations stressing safe use of hand tools.

9. Provide instruction on what to do in case of an accident.

10. Develop information sheets dealing with the safe use of specific machines.

11. Give demonstrations on the proper use and care of personal protective devices.

*These responsibilities are necessary for inclusion in all trade and industry programs in the State of Nebraska.

12. Develop information sheets dealing with the general safety rules for the trade.

13. Enclose all gears, moving belts, and other power transmission devices with permanent guards.

14. Prohibit students from operating machines when instructor is not present.

15. Prohibit the removal of guards and safety devices, even for a brief period, without the approval of the instructor.

16. Prohibit more than one operator from using a machine at one time.

17. Determine personal liability factors and liability coverage afforded through your school.

18. Provide for the bulk storage of flammable material

19. Mark the location of fire-fighting equipment.

20. Post instructions and inform students of building evacuation procedures.

21. Require the wearing of appropriate eye protection as specified by the State of Nebraska eye safety regulations.

22. Keep tools sharp, clean and in good working condition.

23. All shop personnel should be thoroughly familiar with the location of fire extinguishers and the type fire for which each extinguisher is designed.

MACHINE SHOP
(Identified Trade Tasks or Information)

TRADE TASK OR INFORMATION	DATE COMPLETED	TEACHING METHODS USED	TEACHING MATERIALS USED
SAFETY State specific safety rules as they apply to all machines, tools, areas, materials, processes and operations involved in the machining of metals.			
TOOLS AND EQUIPMENT Correctly name and list hand tools commonly used in a machine shop.			
COMPUTATIONS AND ESTIMATIONS Compute speed, feed and depth of cut required in basic machining operations.			

TRADE TASK OR INFORMATION	DATE COMPLETED	TEACHING METHODS USED	TEACHING MATERIALS USED
Interpret tap drill and decimal equivalent charts.			
OPERATIONS AND/OR JOBS			
Identify, list, and define oils and cutting fluids commonly used in a machine shop.			
List common preventive maintenance procedures for various machine tools found in a common machine shop.			
Maintain the basic machine tools found in a common machine shop.			
Grind common lathe cutting tools.			

Decide which equipment or procedure would be most practical in a given situation or operation.

ENGINE LATHE

Mount work between centers.

Perform rough cut and smooth cut on an engine lathe.

File and polish on engine lathe.

Knurl work between centers.

Mount and indicate work in 4-jaw independent chuck.

TRADE TASK OR INFORMATION	DATE COMPLETED	TEACHING METHODS USED	TEACHING MATERIALS USED
Set-up and use 3-jaw universal, and collet chucks.			
Mount workpiece on mandrel.			
Perform compound rest method of tapering.			
Perform taper attachment method of tapering.			
Chase external threads.			
Chase internal threads.			
Cut threads with bottom die and tap.			
Explain uses for cut-off tool.			

Perform facing operation.

Perform boring operation.

BORING, DRILLING & REAMING

Demonstrate knowledge of drilling, drill press work and operations and set-ups pertaining to drilling.

Identify commonly used types of drills and elaborate on their applications.

Demonstrate knowledge of factional, letter, and number drills.

Set-up a standard drill press operation and properly locate and drill holes.

TRADE TASK OR INFORMATION	DATE COMPLETED	TEACHING METHODS USED	TEACHING MATERIALS USED
Set-up and perform common reaming operations.			
Identify various types of reamers and elaborate on their specific uses.			
Demonstrate knowledge of countersinking and common types of countersinking tools.			
Demonstrate ability to use common types of counterboring tools.			
Demonstrate knowledge of spotfacing.			
TAP & DIE THREADING			
Demonstrate ability to drill and tap a hole.			

Identify various types or categories of taps.

Distinguish between taper, plug and bottoming taps and elaborate on their specific uses.

Demonstrate knowledge of machines most commonly used for die threading.

Identify various types of dies and elaborate on their specific uses.

Demonstrate ability to use a die in threading a piece of round stock.

Demonstrate knowledge of machines commonly used in machine die threading and tapping.

TRADE TASK OR INFORMATION	DATE COMPLETED	TEACHING METHODS USED	TEACHING MATERIALS USED
MILLING			
Demonstrate ability to make common set-ups on the horizontal and vertical milling machines.			
Identify various milling cutters and elaborate on their uses.			
Discuss climb milling versus conventional milling.			
Demonstrate knowledge of peripheral, face, and end milling.			
Compare milling processes to other basic machining processes.			
List and define types of			

gears such as spur gears, helical gears, etc.

Demonstrate knowledge of various applications of an adjustable fly cutter.

BAND SAWING

Demonstrate knowledge of capabilities and limitations of contour band sawing.

Perform basic band sawing operations and make common set-ups on the vertical band saw.

Identify tooth forms of band saw blades.

Demonstrate ability to make common set-ups on the cutoff band saw and operate the machine.

TRADE TASK OR INFORMATION	DATE COMPLETED	TEACHING METHODS USED	TEACHING MATERIALS USED
Describe the technique of friction band sawing and list its advantages and limitations.			
Explain causes concerned with control of vibration and chatter during machining processes.			
Identify causes of decreased or defective production from machine tools.			
GRINDING			
Demonstrate knowledge of form tools, form tool grinding, and application of form tools.			
Identify and list various types of abrasives used in			

grinding wheels.

Demonstrate knowledge of abrasive belt grinding.

State the necessary information needed to order a specified grinding wheel.

List the precautions in mounting and use of grinding wheels.

Properly grind a drill.

ALLOY, METAL & MACHINING CHARACTERISTICS

Describe the effects of annealing and hardening on machining characteristics of various metals.

TRADE TASK OR INFORMATION	DATE COMPLETED	TEACHING METHODS USED	TEACHING MATERIALS USED
Describe the effects of alloying elements on machining characteristics of various metals.			
Compare the machining characteristics of gray cast iron with those of other metals.			
List the materials used for cutting tools and discuss uses, advantages, disadvantages, and capabilities of each.			
Discuss various machining and grinding procedures and operations which are complementary to tool steel.			
Discuss the capabilities of the various honing			

processes versus other related processes.

Discuss various machining and grinding procedures and operations which are complementary to stainless steel and heat-resisting alloys.

GENERAL COMPETENCIES

List the proper names of parts of all common machine tools and elaborate on their function as it relates to the operation of the machine.

Demonstrate knowledge of multiple-operation machining and of the various machine tools designed to perform a number of operations consecutively or simultaneously or both.

TRADE TASK OR INFORMATION	DATE COMPLETED	TEACHING METHODS USED	TEACHING MATERIALS USED
Express knowledge of employment opportunities in the machining trade and related occupations.			

Appendix A

One of the primary objectives of trade and industrial education is the successful placement of students completing course work in a specific occupation. The following sample application form is included in this guide with the recommendation that the preparation of such forms become a necessary activity for students in all trade and industrial education courses.

APPLICATION FOR EMPLOYMENT

PERSONAL INFORMATION

DATE _____ SOCIAL SECURITY NUMBER _____

NAME _____ (LAST) (FIRST) (MIDDLE)

PRESENT ADDRESS _____ (STREET) (CITY) (STATE)

PERMANENT ADDRESS _____ (STREET) (CITY) (STATE)

PHONE NO. _____ OWN HOME _____ RENT _____ BOARD _____

DATE OF BIRTH _____ HEIGHT _____ WEIGHT _____ COLOR OF HAIR _____ COLOR OF EYES _____

MARRIED _____ SINGLE _____ WIDOWED _____ DIVORCED _____ SEPARATED _____

NUMBER OF CHILDREN _____ DEPENDENTS OTHER THAN WIFE OR CHILDREN _____ CITIZEN OF U. S. A. YES ○ NO ○

IF RELATED TO ANYONE IN OUR EMPLOY, STATE NAME AND DEPARTMENT _____ REFERRED BY _____

EMPLOYMENT DESIRED

POSITION _____ DATE YOU CAN START _____ SALARY DESIRED _____

ARE YOU EMPLOYED NOW? _____ IF SO MAY WE INQUIRE OF YOUR PRESENT EMPLOYER _____

EVER APPLIED TO THIS COMPANY BEFORE? _____ WHERE _____ WHEN _____

EDUCATION	NAME and LOCATION OF SCHOOL	YEARS ATTENDED	DATE GRADUATED	SUBJECTS STUDIED
GRAMMAR SCHOOL				
HIGH SCHOOL				
COLLEGE				
TRADE, BUSINESS OR CORRESPONDENCE SCHOOL				

SUBJECTS OF SPECIAL STUDY OR RESEARCH WORK _____

WHAT FOREIGN LANGUAGES DO YOU SPEAK FLUENTLY? _____ READ _____ WRITE _____

U. S. MILITARY OR NAVAL SERVICE _____ RANK _____ PRESENT MEMBERSHIP IN NATIONAL GUARD OR RESERVES _____

(CONTINUED ON OTHER SIDE)

FORMER EMPLOYERS (LIST BELOW LAST FOUR EMPLOYERS, STARTING WITH LAST ONE FIRST.)

DATE MONTH AND YEAR	NAME AND ADDRESS OF EMPLOYER	SALARY	POSITION	REASON FOR LEAVING
FROM				
TO				
FROM				
TO				
FROM				
TO				
FROM				
TO				

REFERENCES: GIVE BELOW THE NAMES OF THREE PERSONS NOT RELATED TO YOU, WHOM YOU HAVE KNOWN AT LEAST ONE YEAR.

	NAME	ADDRESS	BUSINESS	YEARS ACQUAINTED
1				
2				
3				

PHYSICAL RECORD:

LIST ANY PHYSICAL DEFECTS

WERE YOU EVER INJURED? GIVE DETAILS

HAVE YOU ANY DEFECTS IN HEARING? IN VISION? IN SPEECH?

IN CASE OF EMERGENCY NOTIFY

NAME ADDRESS PHONE NO.

I AUTHORIZE INVESTIGATION OF ALL STATEMENTS CONTAINED IN THIS APPLICATION. I UNDERSTAND THAT MISREPRESENTATION OR OMISSION OF FACTS CALLED FOR IS CAUSE FOR DISMISSAL. FURTHER, I UNDERSTAND AND AGREE THAT MY EMPLOYMENT IS FOR NO DEFINITE PERIOD AND MAY, REGARDLESS OF THE DATE OF PAYMENT OF MY WAGES AND SALARY, BE TERMINATED AT ANY TIME WITHOUT ANY PREVIOUS NOTICE.

DATE SIGNATURE

DO NOT WRITE BELOW THIS LINE

INTERVIEWED BY DATE

REMARKS:

NEATNESS		CHARACTER	
PERSONALITY		ABILITY	

HIRED FOR DEPT. POSITION WILL REPORT? SALARY WAGES

APPROVED: 1. EMPLOYMENT MANAGER 2. DEPT. HEAD 3. GENERAL MANAGER

Appendix B

One of the most important parts of any trade and industrial education course is a safety program. The following form is recommended for use in courses of this type.

SAMPLE
TRADE AND INDUSTRIAL EDUCATION
INJURY REPORT* **

Student injured _____ Date _____

Shop in which accident occurred _____ Time _____

Instructor in charge _____

Nature of injury _____

_____

First aid administered _____

_____ By whom? _____

Cause of injury _____

_____

Could injury have been prevented? ____ How? _____

_____

Action taken or recommendations made to prevent recurrence _____

Remarks: _____

_____

_____

Signed _____
(Person making report)

Witnesses: _____

Names _____
and
Addresses _____

*Complete in Duplicate
**File one copy in office

Ac-007 523

RECOMMENDED TEXTS AND REFERENCES
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